



OK210 Users Manual

Part I - Hardware



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OK210 is an Embedded Computer (Single Board Computer) based on the 1GHz Samsung S3C6410 (ARM11) microcontroller. OK210 embodies abundant of built-in resources and powerful video processing capacity, which make the OK210 reliable for the development of higher-end products.

Together with the OK210 we provide BSPs (Board Support Packages) for Embedded Linux, WindowsCE and Android including basic drivers for all the components on the board and illustrating programs, which we believe can help the users in understanding the ARM architecture and shortening their development circle.

Here are some dos and don'ts for using the OK210:

1. After opening the OK210 package, please check and make sure that the following components are all enclosed:
 - 1 × OK210 board
 - 1 × serial port cable
 - 1 × USB cable
 - 1 × Ethernet cable
 - 1 × 5V power supply
 - 1 × DVD
2. **DO NOT plug/ unplug the core board when power is on.**
3. **The core board connector should not be touched by finger or oil.**
4. When using the Development Board for the first time, please do **read and follow the user manual** to prevent unnecessary troubles and damages.
5. Every time before powering on the Development Board, please touch anyone of the metallic interface with your fingers to unload the Electrostatic. **Do not touch the chips with your fingers!**
6. **Before physically operating the Development Board, please switch the power off. Hot plugging is **not** supported except on the USB and Ethernet interfaces.**
7. We provide for the OK210 12 weeks' guarantee (in the precondition of non-artificial damage) and 24 weeks technical support.

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1. Brief Introduction

1.1 Cortex-A8

The ARM Cortex™-A8 processor is based on the ARMv7 architecture and has the ability to scale in speed from 600MHz to greater than 1GHz. The Cortex-A8 processor can meet the requirements for power-optimized mobile devices needing operation in less than 300mW; and performance-optimized consumer applications requiring 2000 Dhrystone MIPS.

The Cortex-A8 high-performance processor is proven in end devices today. From high-end feature phones to netbooks, DTVs, printers and automotive-infotainment, the Cortex-A8 processor offers a proven high-performance solution with millions of units shipped annually.

Key features of the Cortex-A8 core are:

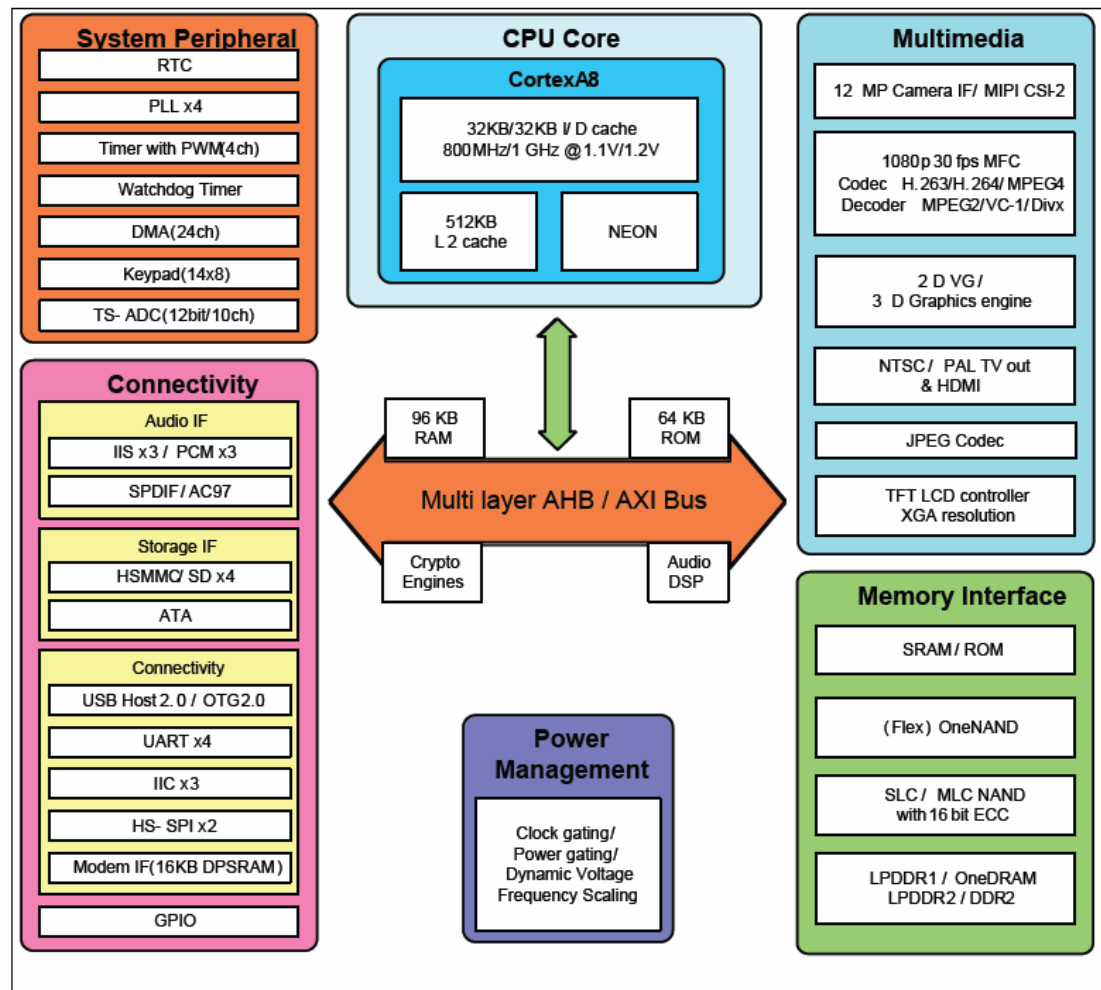
- Frequency from 600 MHz to 1 GHz and above
- Superscalar dual-issue microarchitecture
- NEON SIMD instruction set extension (optional)
- VFPv3 Floating Point Unit (optional)
- Thumb-2 instruction set encoding
- Jazelle RCT
- Advanced branch prediction unit with >95% accuracy
- Integrated level 2 Cache (0-4 MB)
- 2.0 DMIPS / MHz
- Binary compatibility with ARM926, ARM1136, and ARM1176 Processors

1.2 S5PV210

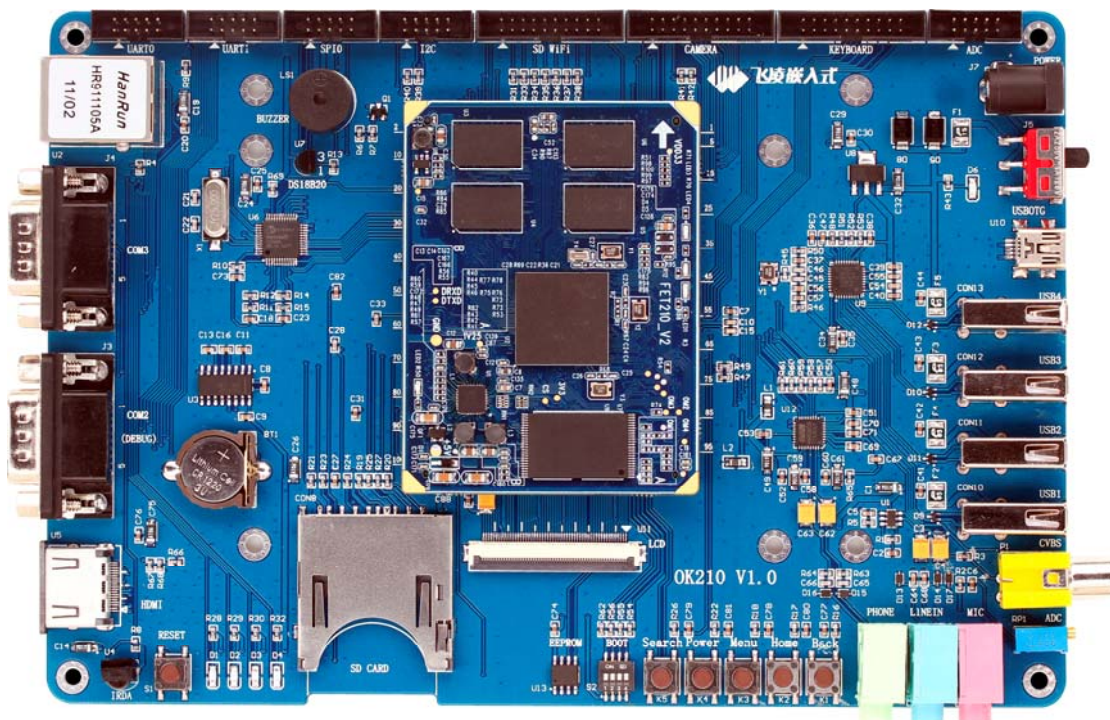
S5PV210 is a 32-bit RISC cost-effective, low power, and high performance microprocessor solution for mobilephones and general applications. It integrates the ARM Cortex-A8 core, which implements the ARM architectureV7-A with supporting peripherals.

S5PV210 includes many hardware peripherals such as TFT 24-bit true color LCD controller, Camera Interface, MIPI DSI, CSI-2, System Manager for power management, ATA interface, four UARTs, 24-channel DMA, four Timers, General I/O Ports, three I2S, S/PDIF, three IIC-BUS interface, two HS-SPI, USB Host 2.0, USB 2.0 OTG operating at high speed (480Mbps), four SD Host and high-speed Multimedia Card Interface, and four PLLs for clock generation.

Block Diagram:

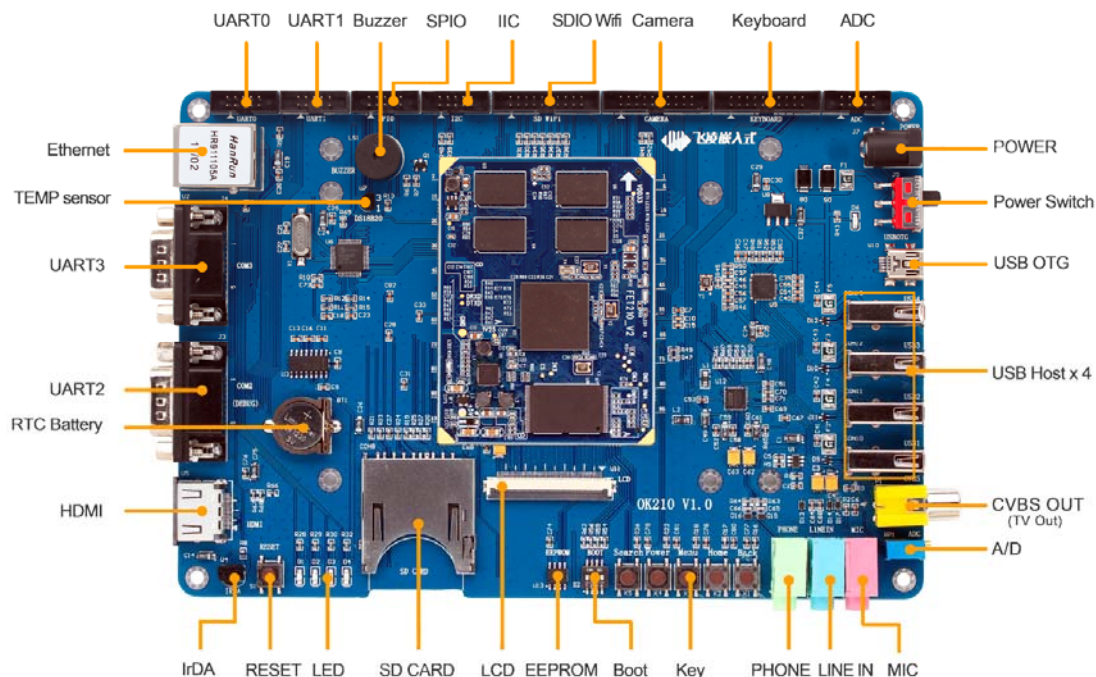


1.3 OK210





The Witech OK210 is a compact high-performance Single Board Computer based on the Samsung Cortex-A8 1GHz S5PV210 microcontroller, carrying the 1GHz S5PV210 microcontroller, 512MB DDRII RAM, 256MB NAND Flash and abundant useful interfaces such as VGA, HDMI, TV, CAMERA, USB, SD, LCD, Ethernet, RS485, industrial CAN Bus and etc, makes the OK210 SBC a powerful device for developing and implementing high-end Set-top Box, Digital TV, Netbook, Smartphone, handheld/3G Mobile devices and intelligent control devices.



Hardware resources on OK210 include:

- ◆ Samsung S5PV210 ARM Cortex-A8 microcontroller, main frequency @ 1GHz;
- ◆ 512MB DDR RAM;
- ◆ 1GB NAND Flash;
- ◆ 4 serial ports, including 2 5-wire RS232 (DB9) and 2 3-wire
- ◆ 1 Ethernet port, 10M/ 100M auto-adaptive;
- ◆ 4 USB Host interface supporting USB2.0 protocol;
- ◆ 1 USB OTG interface supporting USB2.0 protocol;
- ◆ 1 high-speed SD card slot supporting up to 32GB SDHC card;
- ◆ 1 TF card slot;
- ◆ 1 SDIO WIFI connector;
- ◆ 1 CMOS camera connector supporting OV3640 3MP CMOS Camera;
- ◆ 1 HDMI interface;
- ◆ 1 CVBS output interface;
- ◆ 1 54pin LCD interface;
- ◆ 3 3.5mm Stereo audio I/O sockets, WM9714;
- ◆ 1 matrix keyboard connector;

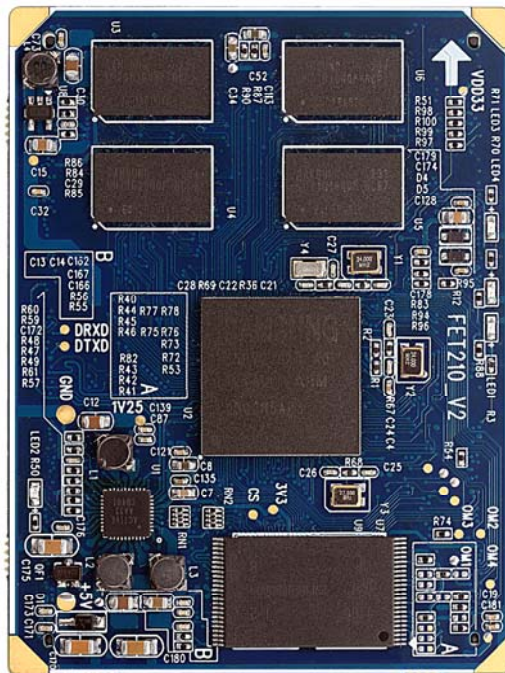


- ◆ 1 JTAG interface;
- ◆ 1 Active Buzzer;
- ◆ 4 LEDs;
- ◆ 1 18b20 temperature sensor;
- ◆ 1 infrared receiver;
- ◆ 1 reset button;
- ◆ 5 user buttons;
- ◆ Built-in RTC (Real Time Clock) with back-up battery;
- ◆ 1 SPI channel, 10pin 2.0mm connector;
- ◆ 1 IIC channel, 10pin 2.0mm connector;
- ◆ 8 A/D channel, including 4-wire resistive touch screen interface;

Together with the OK210 we provide BSP (Board Support Packages) for Embedded Linux-2.6/ 3.0 and Android 4.0/ 2.3, which provide drivers for all the bottom interfaces, devices and applications.

2. Hardware Features

2.1 OK210-CORE



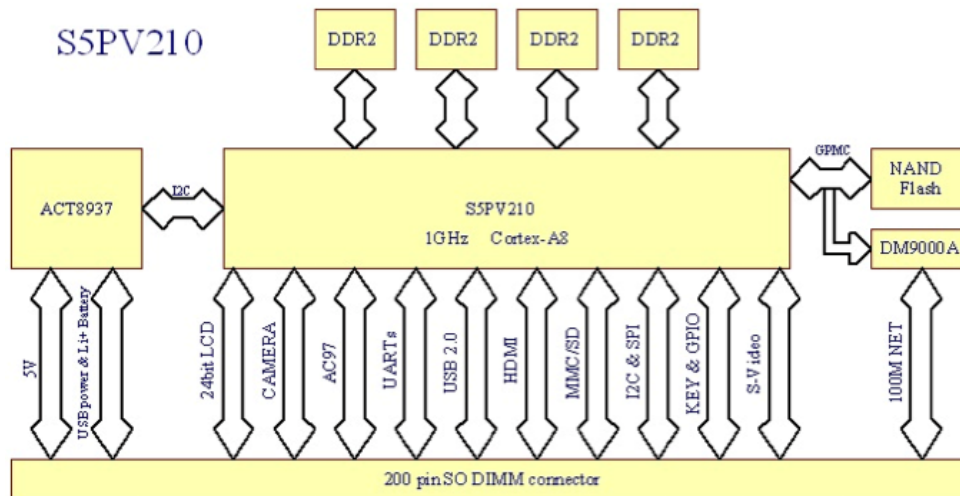
2.1.1 Key Features

OK210-CORE is the core board / controller board of OK210 working as the central controlling unit, main features of OK210-CORE include:

- 8-layer PCB, stable performance tested through temperature, humidity, electromagnetism, vibration and aging.
- 1 GHz S5PV210 microcontroller
- 512M Byte DDRII RAM
- 1GByte SLC NAND Flash
- WM9713 sound card
- DM9000 Ethernet card
- ACT8937 power management chip, supporting USB/Lithium battery power supply and DVS (Dynamic Voltage Scaling)
- Power Consumption: <=300MW
- SODIMM STD 1.8V connector
- Dimension: 60 x 45mm
- Working Temperature: -20°C ~ +70°C
- Storage Temperature: -40°C ~ +85°C

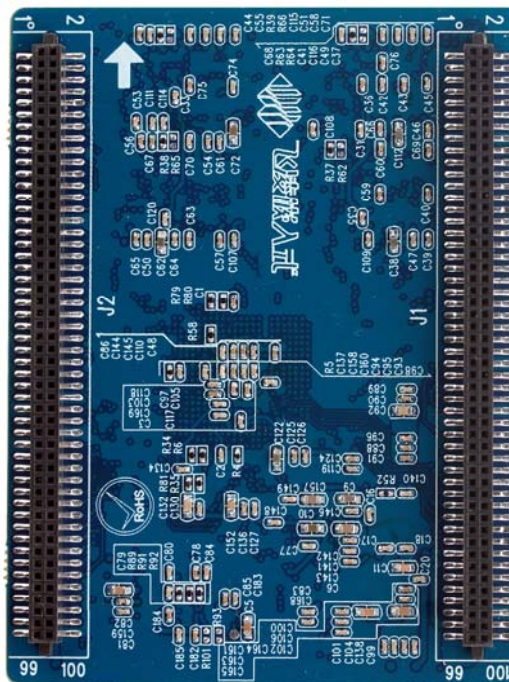


2.1.2 Block Diagram



2.1.3 Core Board Connector

The Core board connector (J1 and J2 as shown in the picture below) lead out the following resources:

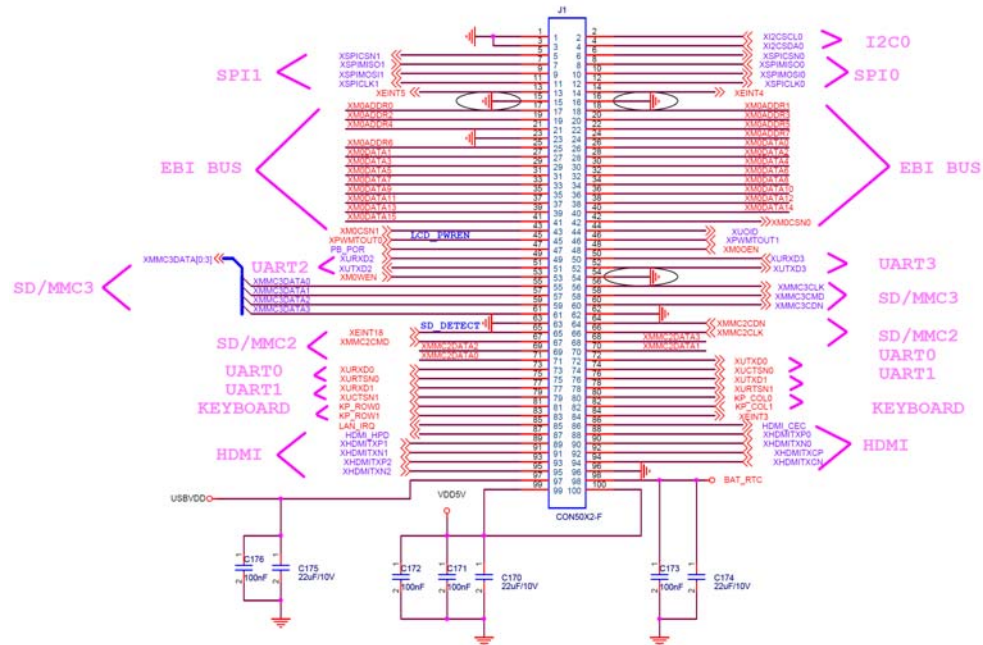


- RGB 24bit LCD interface
- HDMI interface
- CVBS (TV-OUT)
- 8 AD channel (including 4-wire resistive touch screen interface)
- 1 Camera interface
- 2 I2C channels
- 2 SPI channels
- 4 UART (2 3-wire and 2 5-wire)

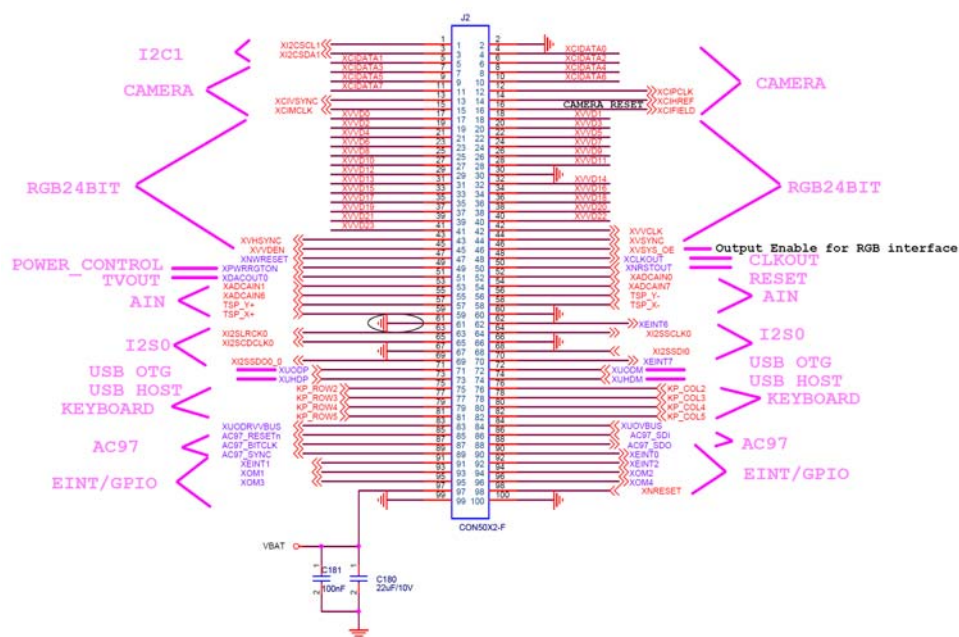


- 1 USB Host 2.0
- 1 USB OTG 2.0
- 1 AC97 audio interface
- 2 SD/MMC interface
- 16bit parallel bus
- 6x6 matrix keyboard interface
- 20 external interrupt EINT
- BOOT_SEL switch

J1:

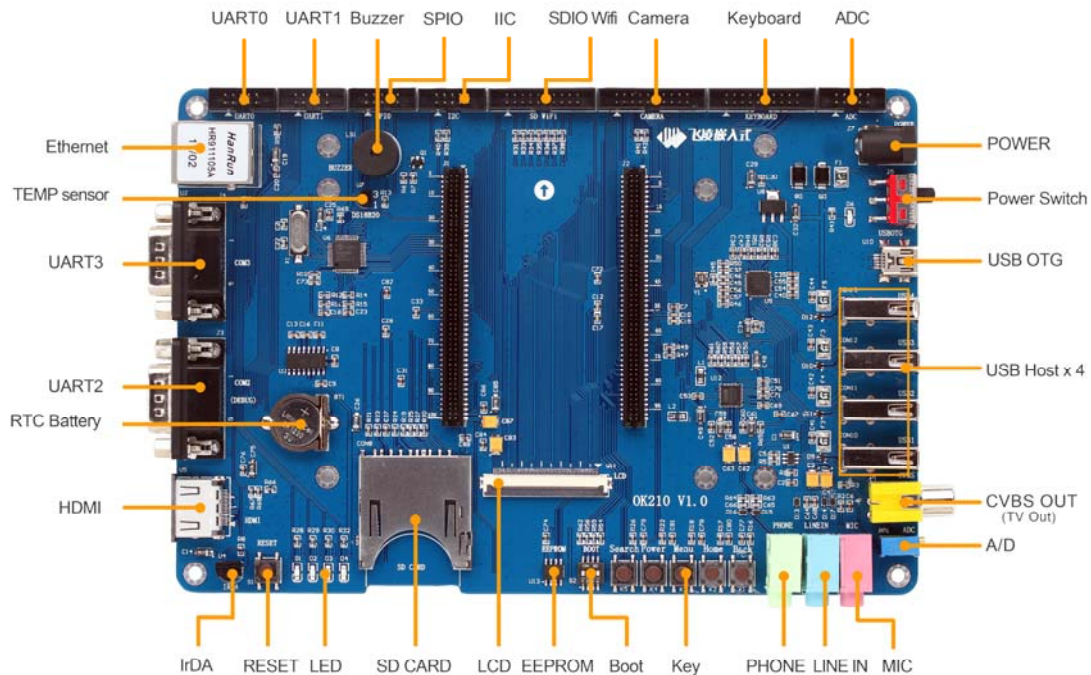


J2:





2.2 OK210 Carrier Board



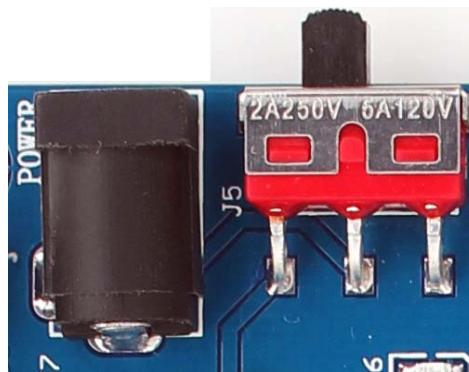
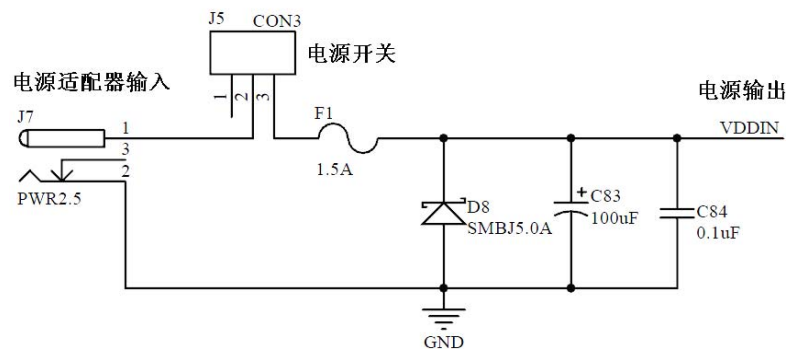
The OK210 Carrier board dimensions 190x130mm, carrying the following resources:

- 1 x power supply connector
- 1 x power switch
- 3 x audio I/O sockets
- 4 x UART (2 x RS232 and 2 x LVTTL)
- 1 x HDMI interface
- 1 x TFT LCD interface
- 1 x SD card slot
- 1 x CVBS connector
- 4 x USB 2.0 Host
- 1 x USB 2.0 Device
- 1 x SPI interface
- 2 x I2C interface
- 1 x ADC interface
- 1 x matrix keypad connector
- 1 x Camera interface
- 1 x Ethernet interface
- 5 x buttons
- 4 x LEDs
- 1 x Infrared receiver
- 1 x temperature sensor



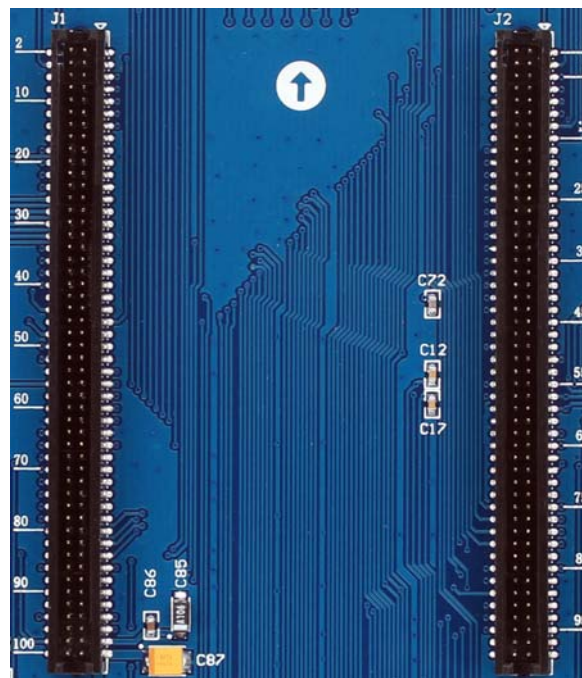
2.2.1 Power Supply and Switch

The OK210 is powered by 5V DC:



2.2.2 Core Board Connector

The J1 and J2 female connectors are used for connecting the OK210-CORE core board.



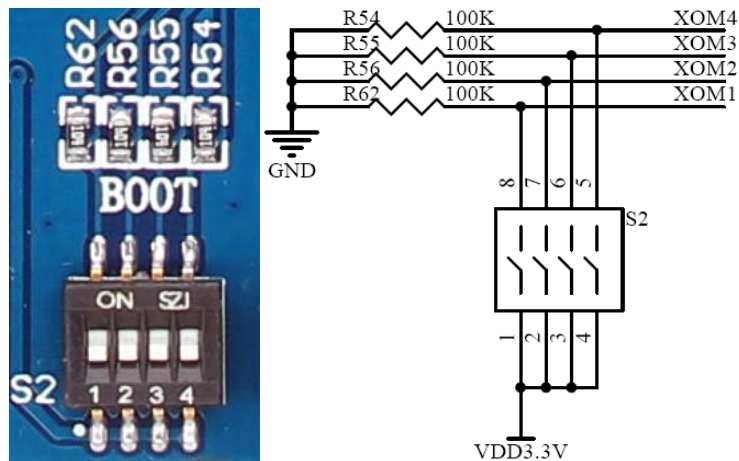
When connecting the core board, please connect J1 to J1, and J2 to J2. Otherwise the core board could be damaged.



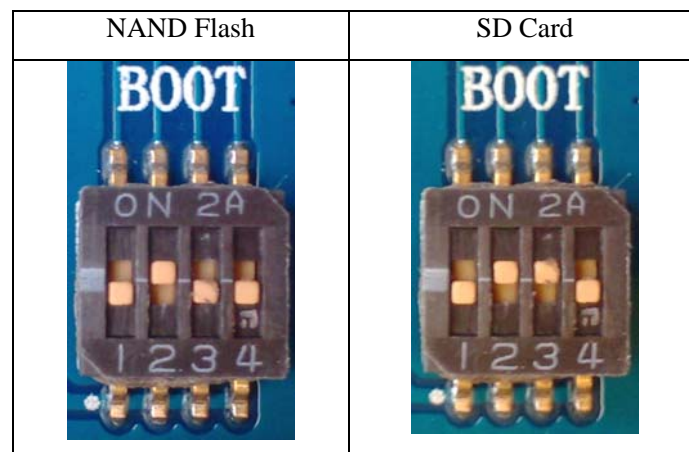
2.2.3 BOOT_SEL switch

The OK210 can be booted from either NAND Flash or SD card, controlled by XOM[1:4]. Read the S5PV210 datasheet for details of boot selection.

A 4bit toggle switch, labeled as “S2” on the carrier board, is used for configuring the boot source.



Switch	1	2	3	4
Boot From				
NAND Flash	OFF	ON	OFF	OFF
SD Card	OFF	ON	ON	OFF



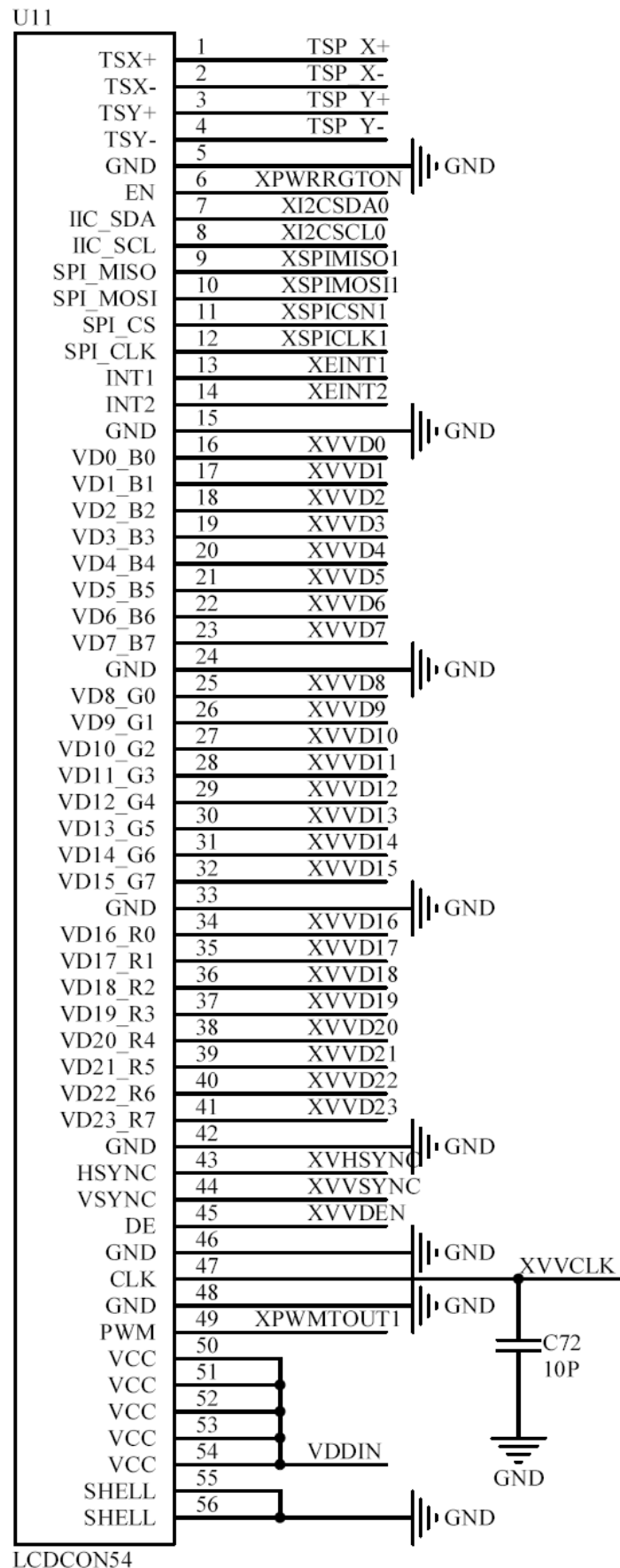
2.2.4 LCD Interface

OK210 carries a 54pin FPC universal interface for connecting our LCDs.





1) Schematic



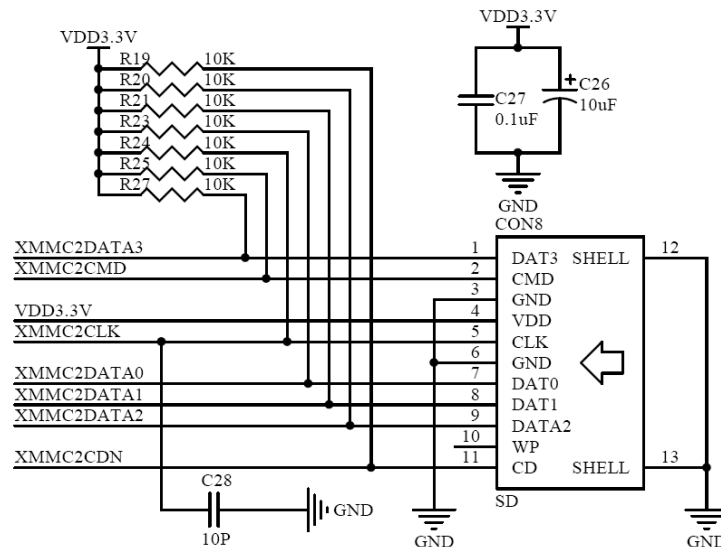


2.2.5 SD Card Slot

The SD card slot is connected by 11 pins. The pin number (from left to right in the picture below) is 10, 8, 7, 6, 5, 4, 3, 11, 2, 1, 9.



1) Schematic



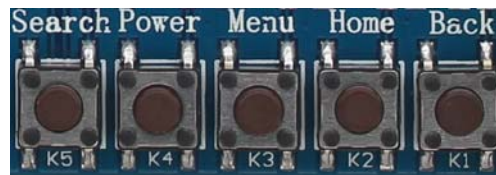
2) Function pins

Pin #	Signal	Connected To	Description	Type
1	DAT3	XMMC2DATA3	Bidirectional data signal bit 3	LVC MOS(3.3V)
2	CMD	XMMC2CMD	command/ respond signal	LVC MOS(3.3V)
3	GND	GND	Power ground	Power
4	VDD	VDD3.3V	Power supply	Power
5	CLK	XMMC2CLK	SD card clock	LVC MOS(3.3V)
6	GND	GND	Power ground	Power
7	DAT0	XMMC2DATA0	LVC MOS(3.3V)	LVC MOS(3.3V)
8	DAT1	XMMC2DATA1	Bidirectional data signal bit 1	LVC MOS(3.3V)
9	DAT2	XMMC2DATA2	Bidirectional data signal bit 2	LVC MOS(3.3V)
10	WP	NC	Write-Protect signal	NC
11	CD	XMMC2CDN	SD card enable signal	LVC MOS(3.3V)

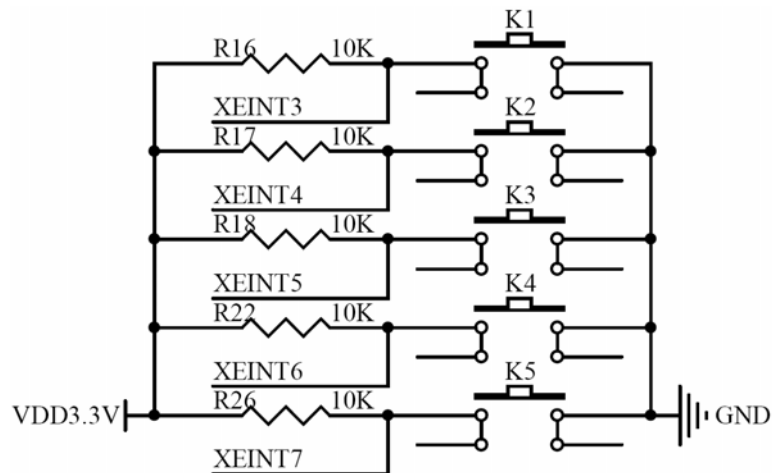


2.2.6 User Buttons

There are 5 user programmable buttons on the OK210, labeled as “K1”, “K2”, “K3”, “K4” and “K5”, connected to S5PV210 external interrupt and toggled by lower power level.



1) Schematic:

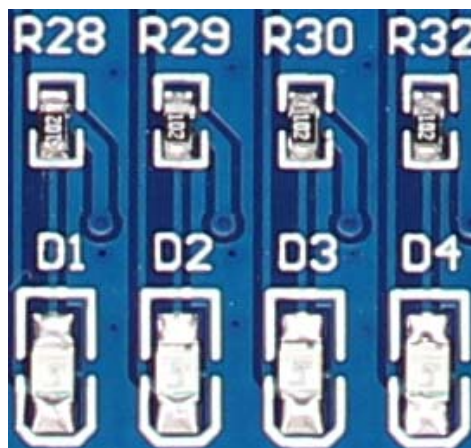


2) Pins

Key	Connected To	Description	Type
K1	XEINT3	S5PV210 external interrupt 3	LVC MOS(3.3V)
K2	XEINT4	S5PV210 external interrupt 4	LVC MOS(3.3V)
K3	XEINT5	S5PV210 external interrupt 5	LVC MOS(3.3V)
K4	XEINT6	S5PV210 external interrupt 6	LVC MOS(3.3V)
K5	XEINT7	S5PV210 external interrupt 7	LVC MOS(3.3V)

2.2.7 LED

There are four LEDs on the OK210 labeled as “D1”, “D2”, “D3”, “D4”.

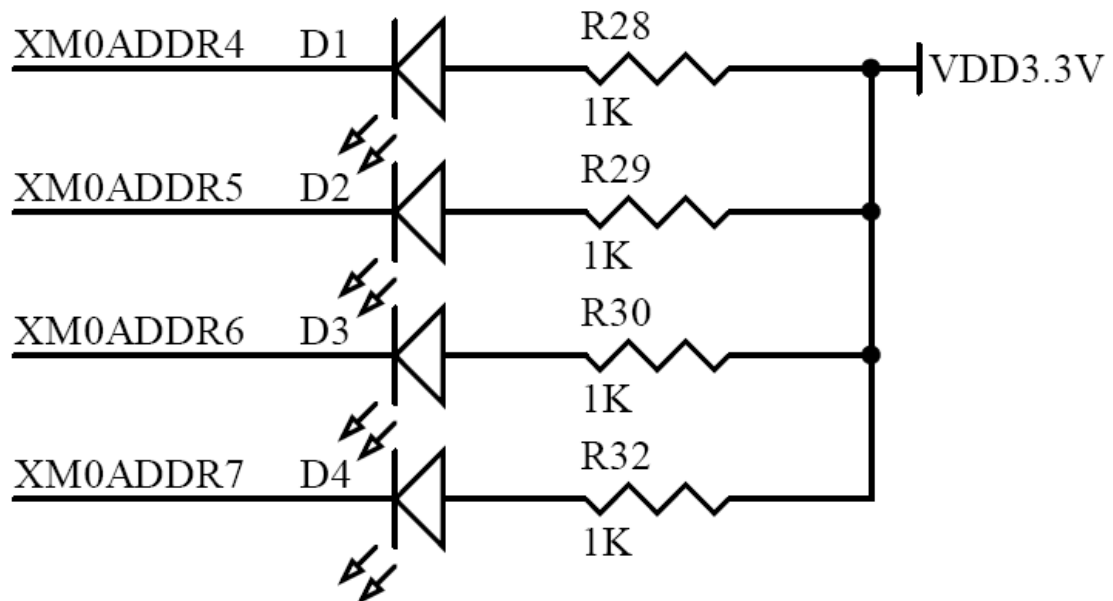




1) Function pins

LED	Connected to	Description	Type
D1	XM0ADDR4	S5PV210 user IO MP0_44	LVC MOS(3.3V)
D2	XM0ADDR5	S5PV210 user IO MP0_45	LVC MOS(3.3V)
D3	XM0ADDR6	S5PV210 user IO MP0_46	LVC MOS(3.3V)
D4	XM0ADDR7	S5PV210 user IO MP0_47	LVC MOS(3.3V)

2) Schematic



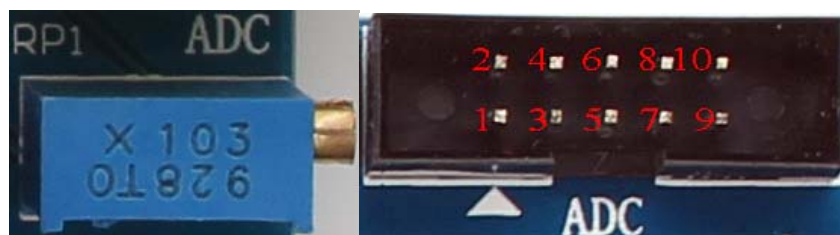
3) Description

The four LEDs are respectively connected to four pins on the core board connector: “XM0ADDR4”, “XM0ADDR5”, “XM0ADDR6”, “XM0ADDR7”.

To control the LEDs we need to first set the corresponding pins as GPIO, and then set the power level: Low power level turns the LEDs on and high PL turns them off.

2.2.8 ADC

There two ADC channels on the OK210, one connected to an adjustable resistance (RP1) for ADC demonstration/ testing, and the other led out to a 5x2pin connector for user programmable ADC:





2) Function pins

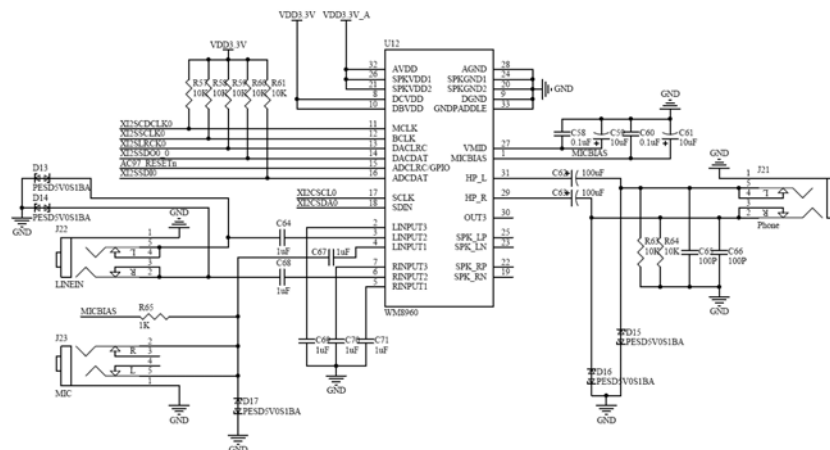
Pin #	Signal	Connected To	Description	Type
1	XADCAIN6	XADCAIN6	S5PV210 Analog input 6	ANALOG
2	XADCAIN7	XADCAIN7	S5PV210 Analog input 7	ANALOG
3	TSP_Y-	TSP_Y-	S5PV210 Analog input2(YM0)	ANALOG
4	GND	GND	Power ground	Power
5	VDD	VDDIN	5V power input	Power
6	VDD	VDDIN	5V power input	Power
7	GND	GND	Power ground	Power
8	TSP_Y+	TSP_Y+	S5PV210 Analog input 3(YP0)	ANALOG
9	TSP_X+	TSP_X+	S5PV210 Analog input 5(XP0)	ANALOG
10	TSP_X-	TSP_X-	S5PV210 Analog input4(XM0)	ANALOG

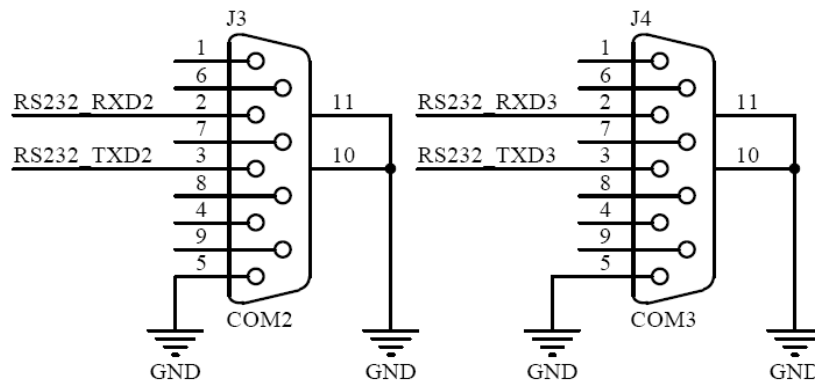
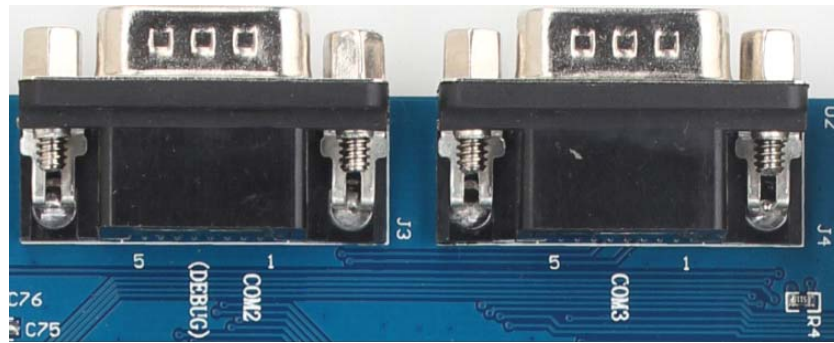
2.2.9 Audio

The audio function is carried out by three 3.5mm audio sockets, implemented by WM8960 audio codec chip, connected to S5PV210 via IIS serial audio bus.



1) Schematic





UART0 and UART1 can be used for connecting our GPS and GPRS modules, as well as other universal serial port devices.

1) Function pins

UART0:

Pin #	Signal	Connected To	Description	Type
1	CTS	XUCTSN0	Sending acceptance	LVC MOS(3.3V)
2	RTS	XURTSN0	Sending request	LVC MOS(3.3V)
3	TXD	XUTXD0	Data sending	LVC MOS(3.3V)
4	GND	GND	Power ground	Power
5	VDD	VDDIN	5V power input	Power
6	VDD	VDDIN	5V power input	Power
7	GND	GND	Power ground	Power
8	RXD	XURXD0	Data receiving	LVC MOS(3.3V)
9	EN	XPWRRGTON	Reserved enable signal	LVC MOS(3.3V)
10	INT	AC97_SDI	Reserved interrupt signal	LVC MOS(3.3V)

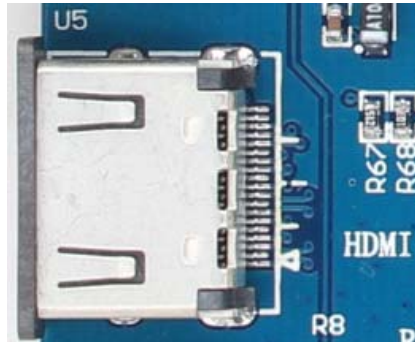
UART1:

Pin #	Signal	Connected To	Description	Type
1	CTS	XUCTSN1	Sending acceptance	LVC MOS(3.3V)
2	RTS	XURTSN1	Sending request	LVC MOS(3.3V)
3	TXD	XUTXD1	Data sending	LVC MOS(3.3V)
4	GND	GND	Power ground	Power

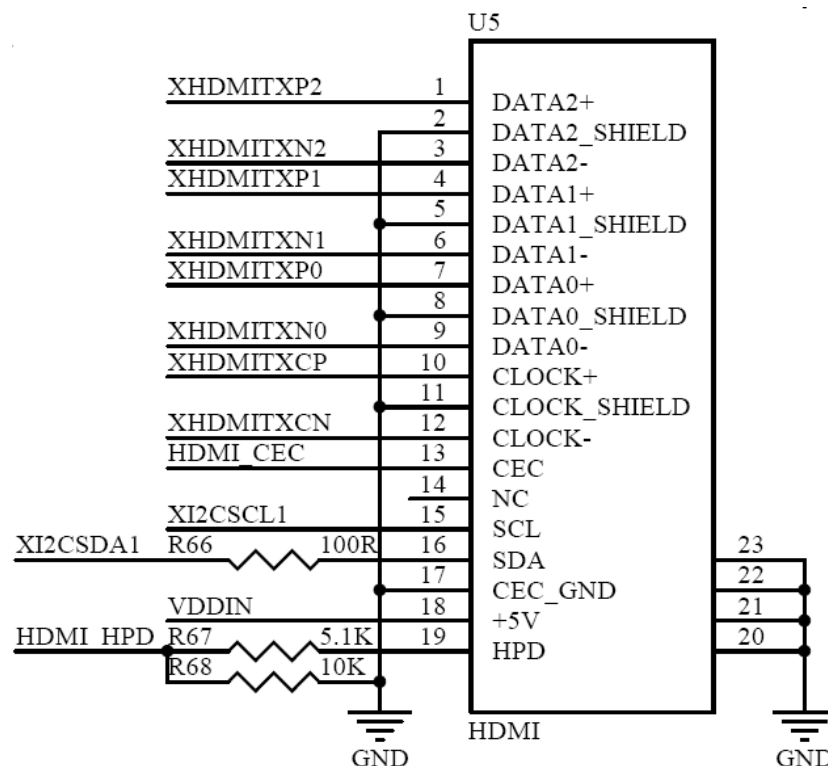


5	VDD	VDDIN	5V power input	Power
6	VDD	VDDIN	5V power input	Power
7	GND	GND	Power ground	Power
8	RXD	XURXD1	Data receiving	LVTMOS(3.3V)
9	EN	XPWRRGTON	Reserved enable signal	LVTMOS(3.3V)
10	INT	AC97_SD0	Reserved interrupt signal	LVTMOS(3.3V)

2.2.11 HDMI Interface

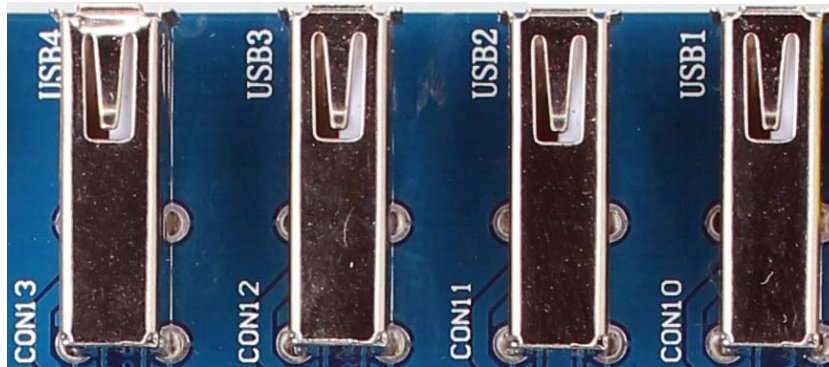


1) Schematic

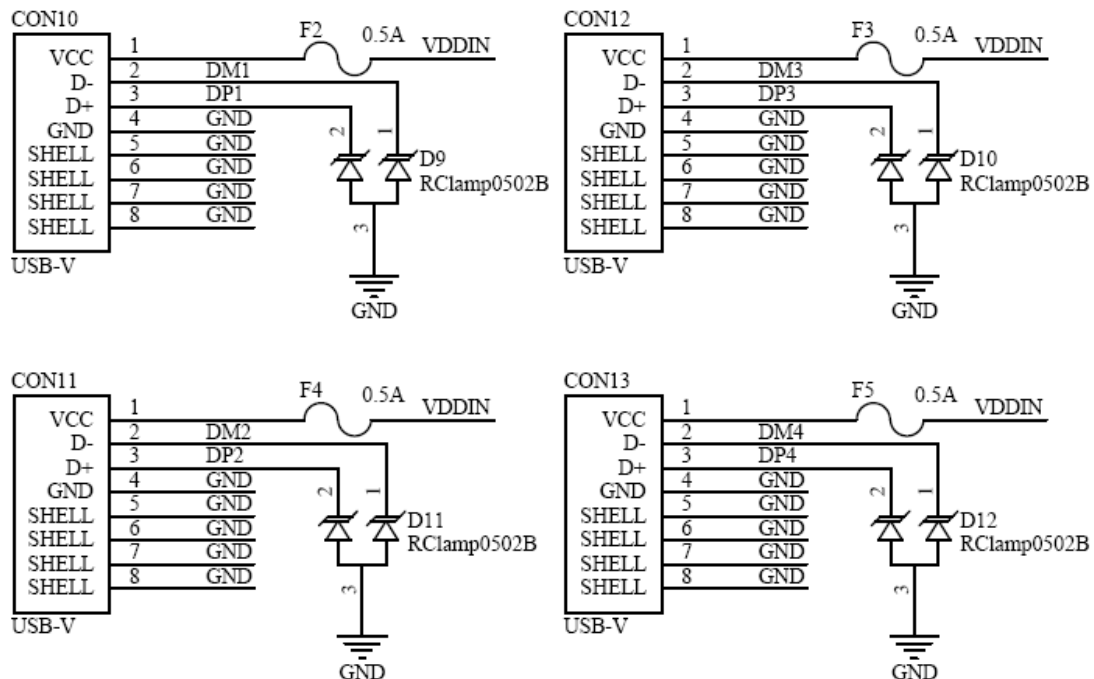




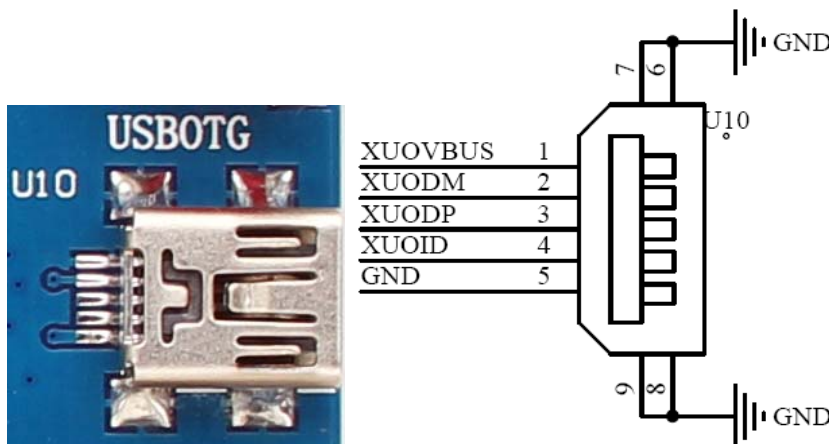
2.2.12 USB Host Interfaces



1) Schematic



2.2.13 USB OTG Interfaces



**2.2.14 SPI interface**

1) Function pins

Pin #	Signal	Connected To	Description	Type
1	SPICLK	XSPICLK0	Clock output	LVC MOS(3.3V)
2	INT	AC97_BITCLK	Reserved interrupt	LVC MOS(3.3V)
3	CS	XSPICSN0	Chip selection	LVC MOS(3.3V)
4	GND	GND	Power ground	Power
5	VDD	VDDIN	5V power input	Power
6	VDD	VDDIN	5V power input	Power
7	GND	GND	Power ground	Power
8	SPIMOSI	XSPIMOSI0	Host output, device input	LVC MOS(3.3V)
9	EN	XPWRRGTON	Reserved enable signal	LVC MOS(3.3V)
10	SPIMOS0	XSPIMISO0	Host input, device output	LVC MOS(3.3V)

2.2.15 I2C interface

1) Function pins

Pin #	Signal	Connected To	Description	Type
1	SCL0	XI2CSCL0	I2C0 clock output	LVC MOS(3.3V)
2	INT	AC97_SYNC	Reserved interrupt	LVC MOS(3.3V)
3	SDA0	XI2CSDA0	I2C0 Serial data	LVC MOS(3.3V)
4	GND	GND	Power ground	Power
5	VDD	VDDIN	5V power input	Power
6	VDD	VDDIN	5V power input	Power
7	GND	GND	Power ground	Power
8	SDA1	XI2CSDA1	I2C1 Serial data	LVC MOS(3.3V)
9	EN	XPWRRGTON	Reserved enable signal	LVC MOS(3.3V)
10	SCL1	XI2CSCL1	I2C1 clock output	LVC MOS(3.3V)



2.2.16 Camera interface



1) Function pins

Pin #	Signal	Connected To	Description	Type
1	VDD	VDDIN	DC 5V	Power
2	GND	GND	Power ground	Power
3	SDA	XI2CSDA0	I2C serial data	LVC MOS(3.3V)
4	SCL	XI2CSCL0	I2C serial clock	LVC MOS(3.3V)
5	INT	XEINT0	Reserved interrupt	LVC MOS(3.3V)
6	PCLK	XCIPCLK	Pixel clock for camera input	LVC MOS(3.3V)
7	VS YNC	XCIVSYNC	Frame synchronization signal	LVC MOS(3.3V)
8	HREF	XCIHREF	Horizontal synchronization	LVC MOS(3.3V)
9	MCLK	XCIMCLK	Clock signal	LVC MOS(3.3V)
10	FIELD	XCIFIELD	Field synchronization	LVC MOS(3.3V)
11	DATA0	XCIDATA0	Pixel data bit0	LVC MOS(3.3V)
12	DATA1	XCIDATA1	Pixel data bit1	LVC MOS(3.3V)
13	DATA2	XCIDATA2	Pixel data bit2	LVC MOS(3.3V)
14	DATA3	XCIDATA3	Pixel data bit3	LVC MOS(3.3V)
15	DATA4	XCIDATA4	Pixel data bit4	LVC MOS(3.3V)
16	DATA5	XCIDATA5	Pixel data bit5	LVC MOS(3.3V)
17	DATA6	XCIDATA6	Pixel data bit6	LVC MOS(3.3V)
18	DATA7	XCIDATA7	Pixel data bit7	LVC MOS(3.3V)
19	EN	XPWRRGTON	Reserved enable signal	LVC MOS(3.3V)
20	NC	NC	Not connected	NC

2.2.17 SDIO WIFI interface



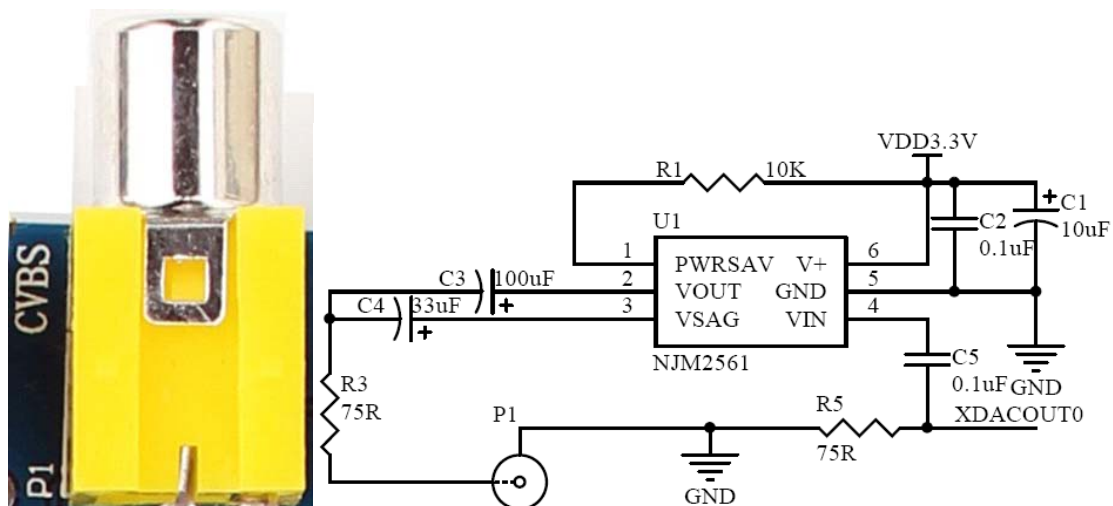
1) Function pins

Pin #	Signal	Connected To	Description	Type
1	VDD	VDDIN	DC 5V	Power



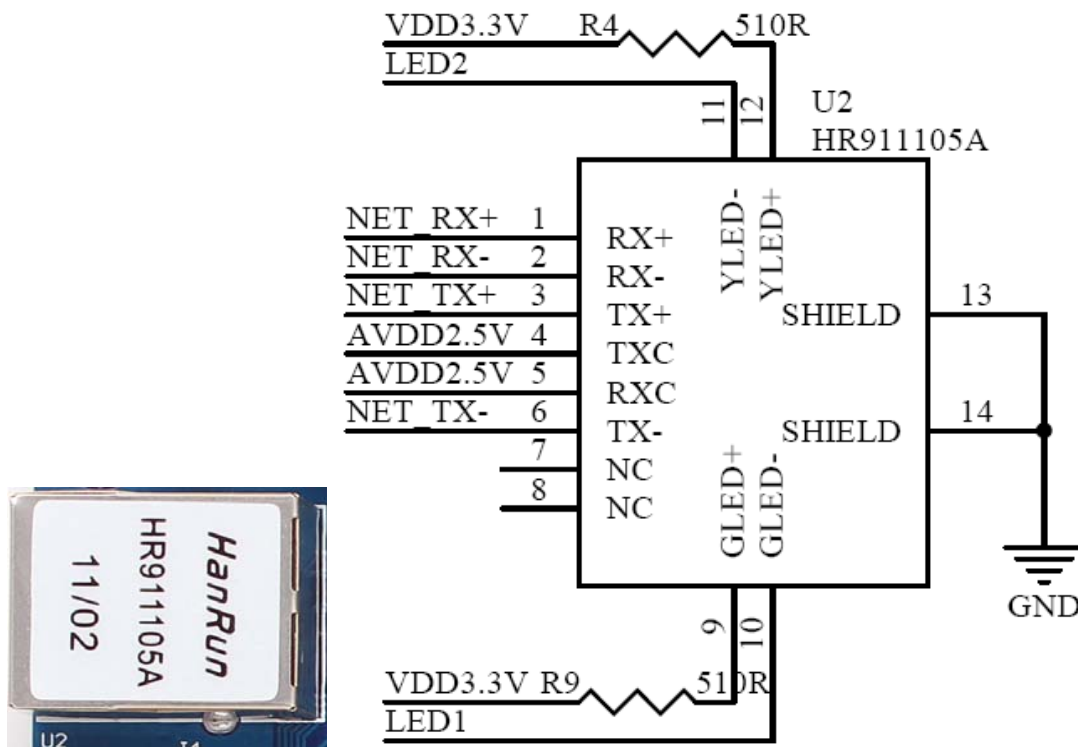
2	GND	GND	Power ground	Power
3	DATA3	XMMC3DATA3	Data bit 3	LVC MOS(3.3V)
4	NC	NC	Not connected	NC
5	DATA2	XMMC3DATA2	Data bit 2	LVC MOS(3.3V)
6	NC	NC	Not connected	NC
7	DATA1	XMMC3DATA1	Data bit 1	LVC MOS(3.3V)
8	NC	NC	Not connected	NC
9	DATA0	XMMC3DATA0	Data bit 0	LVC MOS(3.3V)
10	NC	NC	Not connected	NC
1	CDN	XMMC3CDN	Card status check	LVC MOS(3.3V)
12	NC	NC	Not connected	NC
13	CMD	XMMC3CMD	Command indicator	LVC MOS(3.3V)
14	NC	NC	Not connected	NC
15	CLK	XMMC3CLK	Clock	LVC MOS(3.3V)
16	NC	NC	Not connected	NC
17	INT	XEINT18	Reserved interrupt signal	LVC MOS(3.3V)
18	NC	NC	Not connected	NC
19	EN	XPWRRGTON	Reserved enable signal	LVC MOS(3.3V)
20	NC	NC	Not connected	NC

2.2.18 CVBS connector



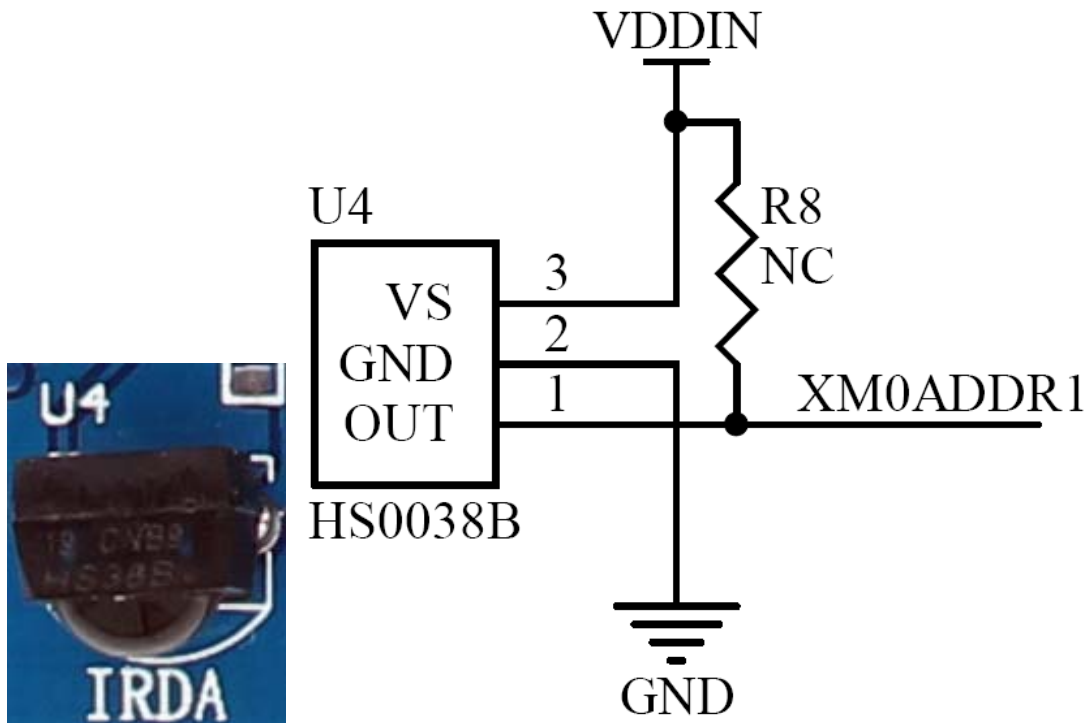
2.2.19 Ethernet

Ethernet on OK210 is implemented by DM9000 Ethernet card and carried out by RJ45 socket.



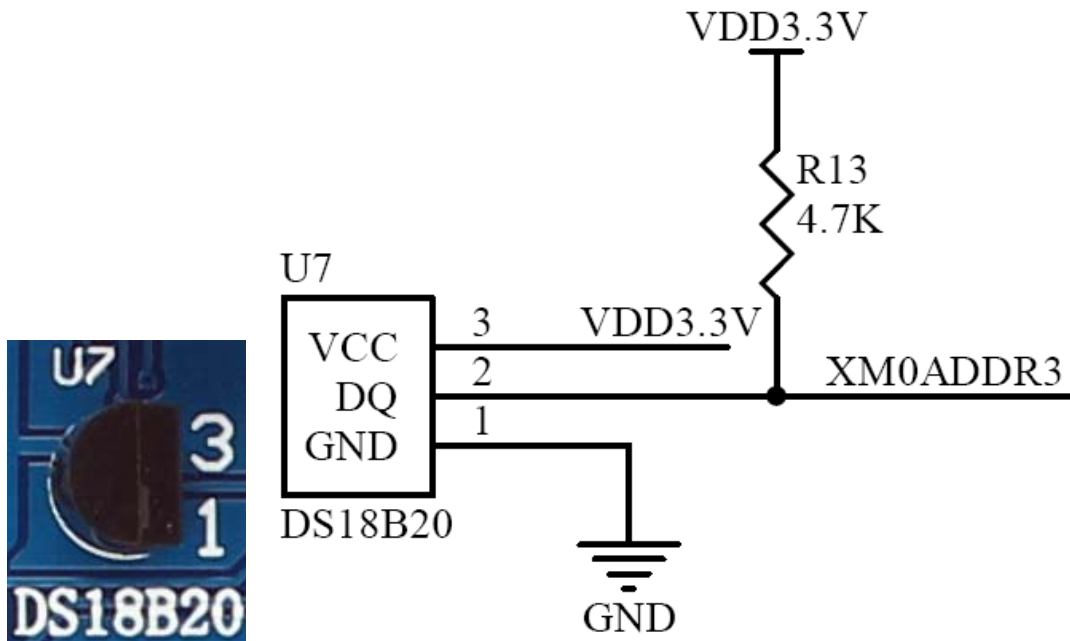
2.2.20 Infrared Receiver

HS0038B is being used on the OK210 as infrared receiver.



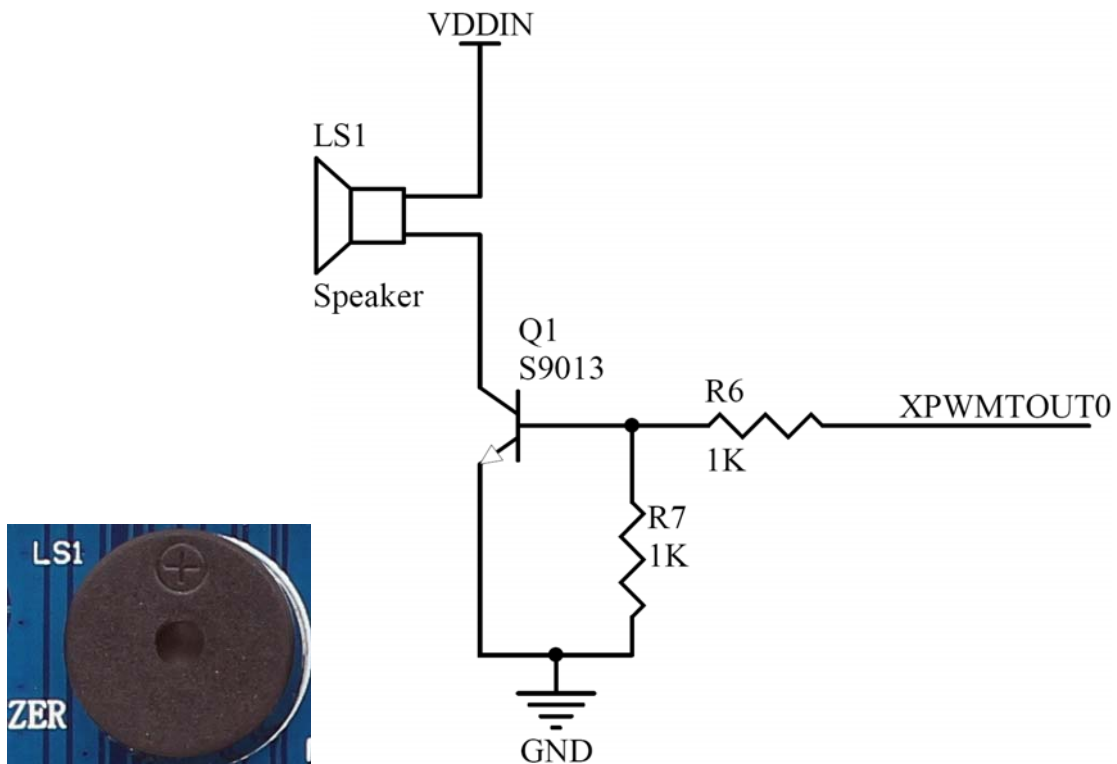
2.2.21 Temperature Sensor

Model number of temperature sensor is DS18B20.



2.2.22 Buzzer and PWM

A buzzer is connected to XPWMOUT0 in the S5PV210 for IROM boot error report, controlled by PWM.

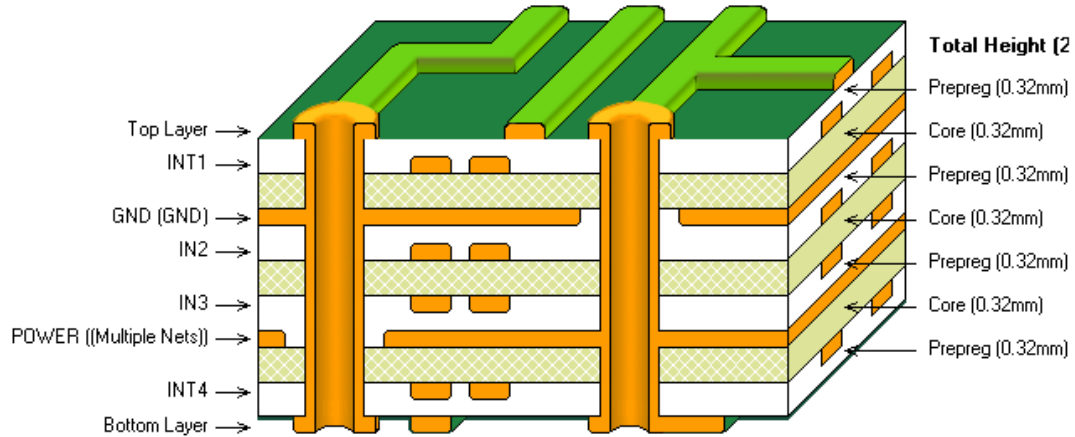




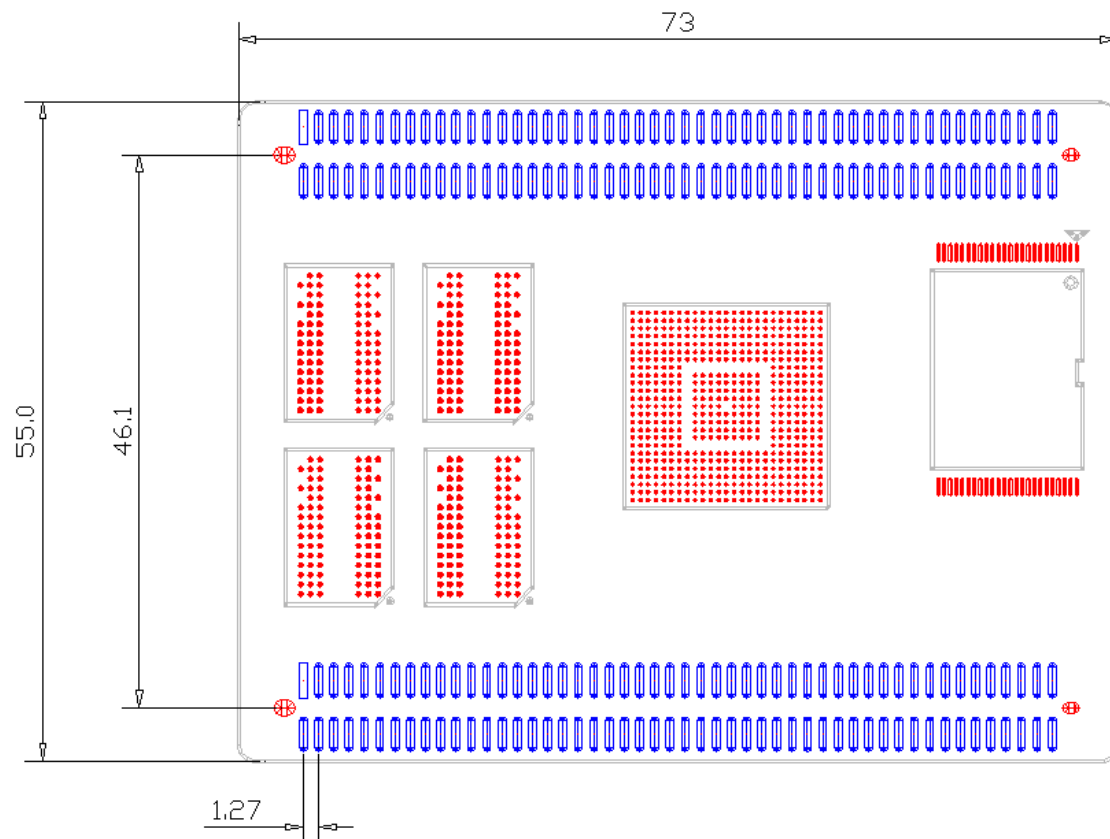
3. Hardware Specifications

3.1 OK210 Core Board

3.1.1 PCB layers



3.1.2 Layout





3.2 OK210 Carrier Board

3.2.1 Layout

